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# THE WATER BARRIERS OF NEW YORK CITY

## By ELLSWORTH HUNTINGTON

When the world was young men dreamed of the power of the gods. They dreamed that Jupiter could fly to the top of Olympus in the twinkling of an eye; Neptune could plunge beneath the water on the coast of Ithaca and emerge a few minutes later at the mouth of the Tiber; Pluto could cleave the ground asunder and descend to the depths of Hades. Today, man no longer dreams of these things. He does them. He flies in the air at the rate of two miles a minute; he plunges to the bottom of the sea and comes up miles away; he blasts the earth asunder and ransacks its deep places for hidden treasure. Where light-hearted Mercury occasionally lifted some happy mortal and winged with him across a broad river, the ordinary mortal can today shoot across a huge steel bridge in the wake of a snorting dragon.

Because we can do these things we flatter ourselves that we have conquered nature, but have we done it? Has not nature conquered us? Take the water as an example. Look at its effect on New York City. Because of the splendid harbor and the wonderful pathway up the Hudson-Mohawk Valley the city has grown beyond the wildest dreams of its founders. Today, if we include the part of the population on the Jersey shore, the real city is scarcely second to London in size and will soon rival or surpass the British capital. Never before in all history have so much gold, bonds, and other valuables been stored in a single metropolis. Never before was there a city which throbbed with so intense a life. All this depends on the fact that man has conquered the water and made it the highway of the nations.

But look at the other side of the shield. We have conquered the water, but what has been the price? How much does New York pay for the privilege of being located on Manhattan Island and thus having a fine harbor? Every one who comes to the city, together with a large portion of the people who dwell there, must frequently cross one or another of the narrow arms of the sea that surround the island on all sides. We conquer these narrow arms by steam ferries, great suspension bridges, and tunnels deep down in the mud and rock. Do we thus diminish the influence of the water barriers? How much did the barriers cost the average citizen of Manhattan in the days when there were no ferries, bridges, and tunnels? And how much do they cost him today? If any man thinks that by our boasted cleverness we have lessened the influence even of such small bodies of water as the North River, the East River, and the petty little Harlem, let him count the cost in money, in time, in health, in character. Looked at in any way except as aids to commerce and as a stimulus to invention and activity these little bodies of water are today more of a hindrance than ever before.

New York City, as everyone knows, was founded on the southern end of Manhattan Island. The island is about 13 miles long with a width of about two miles at the south and one mile at the north. It is surrounded by narrow arms of the sea, wrongly called rivers, which are due to the depression and drowning of the coast in recent geological times. The widest arm is the North River, or main Hudson, one mile wide, which separates Manhattan from New Jersey on the west. The second arm, the East River, one-third to two-thirds of a mile wide, lies southeast of the island toward Brooklyn and Long Island. The little Harlem River, from 500 to 1,000 feet wide, completes the water barrier and separates Manhattan from the mainland on the east.

The ferries have always made trouble for New York. At the very beginning, according to I. N. Phelps Stokes in his book on "The Iconography of Manhattan Island," one of the conditions on which Governor Nicolls granted a patent to the town of New Harlem was that it should maintain a ferry to the mainland. The ferry was established across the Harlem River at Harlem, but thrifty travelers preferred to use the road by Spuyten Duyvil, for there where King's Bridge was afterwards built they could wade across. Traders finally brought so many horses and cattle across there that in 1668 the ferryman, apparently having little to do except sit and think of his wrongs, succeeded in persuading the inhabitants of New Harlem to join him in suing for redress of grievances. As a result the ferry was moved to the wading place, where at least it could carry across the people who did not want to join their animals in wading. The following year, 1669, a license was granted in New Jersey to Pieter Hetfelsen to run a ferry between Communipaw and New York. Thus the first formal steps were taken toward overcoming the water barriers of Manhattan.

In 1790, when the first census of the United States was taken, New York City had 33,000 people, and the modern metropolitan district had scarcely 50,000 people where today there are over 5,000,000. How much were the people of 1790 disturbed by the water barriers? Practically none crossed the water to their daily work. Those who crossed the rivers were chiefly the few travelers who passed through the city and the farmers who lived in Jersey or Brooklyn and came now and then in rowboats to sell produce and do a little buying. The largest ferry boats were mere scows. Although it is impossible to obtain figures as to how much the crossing of the water cost the community in 1790, we may be quite sure that for an entire year it was

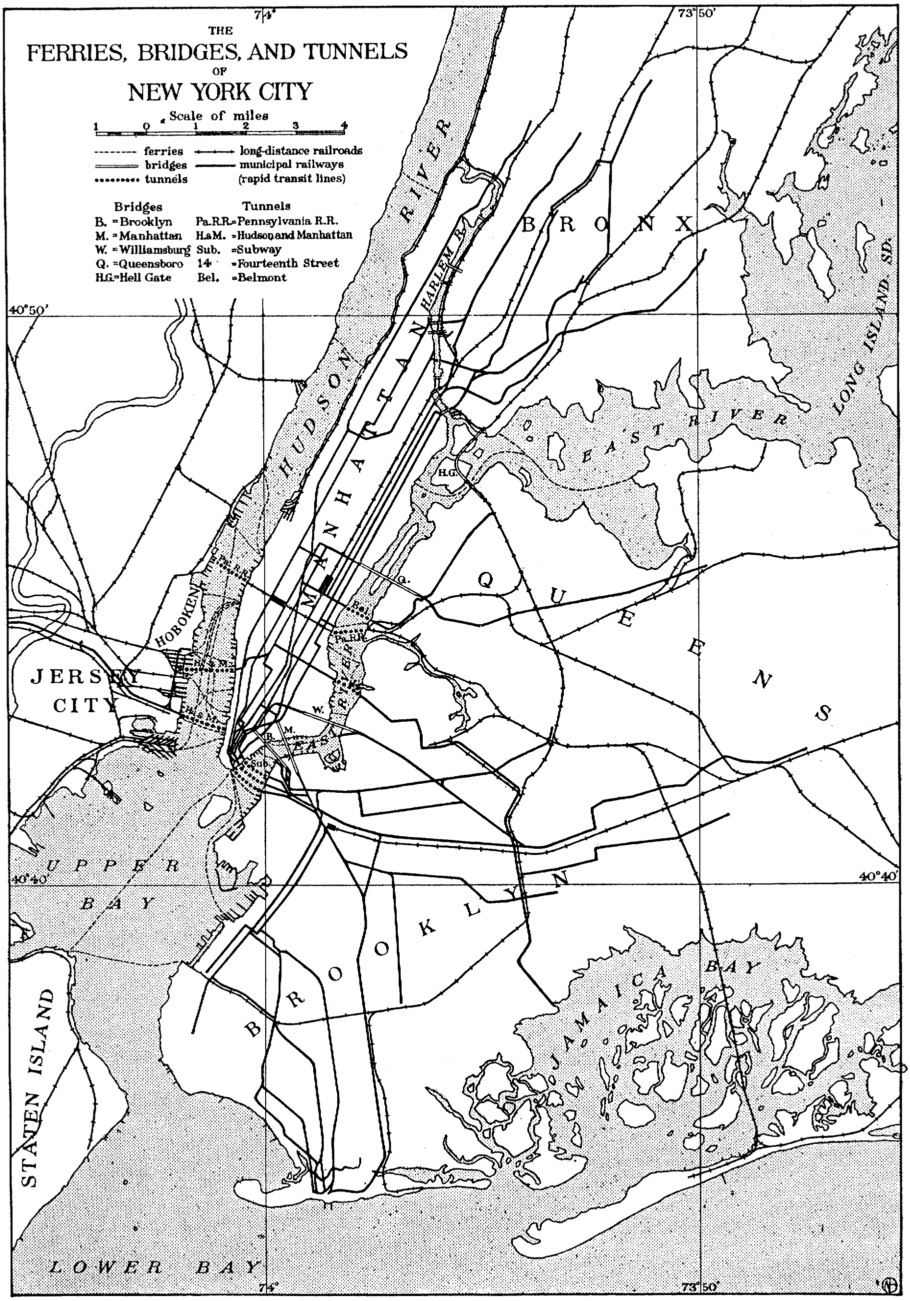

FIG. 1—Sketch-map showing how the water barriers of Manhattan Island have had to be overcome by means of ferries, bridges, and tunnels. Scale, 1:247,000.

only a matter of a few thousand dollars. The milkman may have had to drive a mile or two farther because Manhattan is long and slender, but it is doubtful whether the life of the ordinary New Yorker was appreciably influenced by the fact that he lived on an island rather than on the mainland.

Let us see what the water barriers are doing to New York today. As soon as lower Manhattan began to be densely populated there was trouble. The city was like a growing potato enclosed in a narrow tube. It wanted to expand in all directions, but the only line of growth was northward. Therefore the price of land rose rapidly, for many people wanted the same spot downtown. As Brooklyn and Jersey offered abundant land at prices much lower than in Manhattan, people began to live there and to cross the water to their work. Hence the ferries became important. Today they are a great source of expense not only to the people who use them, but to the municipality and hence to every New Yorker.

Let us estimate the annual expenditure entailed by the ferries. We may well begin with the municipal ferries, which run to South Brooklyn and Staten Island. They were taken over by the city in 1905 and have been operated ever since at a loss. The equipment of these ferries has cost not far from $12,000,000, including boats and especially terminals, which account for about 70 per cent of the cost. To this must be added more than $5,000,000 for the loss in operation from the time when the ferries were taken over by the government to the end of 1914. The interest on $17,000,000 at the rate paid by the city when the ferries were bought and equipped amounts to about $700,000. In 1913 the cost of operating and maintaining the Staten Island Ferry, together with depreciation, amounted to $1,110,000; while the South Brooklyn ferries cost $420,000. Adding together these various items we get a total of $2,230,000 as the cost of the ferries to the city in 1913. This sum paid the interest and carried 1,500,000 passengers to Brooklyn and 12,000,000 to Staten Island.

The municipal ferries are only a small part of those in New York. In 1906, when the last census report on transportation was issued, New York had 152 ferry boats, or 28 per cent of those in the entire country. Their value was $17,000,000, or 58 per cent of the country's total, while the number of passengers was 209,000,000, or 63 per cent of the ferry passengers carried in the United States. Since the building of the tunnels the number of passengers has decreased, but for the year ending in June, 1914, it amounted to 128,000,000 in addition to the 15,000,000 carried by the municipal ferries. The cost of the equipment has not diminished, and, as a result of the development of automobile traffic, more vehicles are carried than ever before. We have no figures as to the operating expenses of the privately owned ferries, but 128,000,000 passengers at the usual rate of three cents each would give $3,840,000 as the amount paid out by the public for this particular item.

Not only passengers but vehicles are carried by the ferries. In 1914 the Staten Island Ferry carried 342,560 vehicles at an average charge of 51 cents apiece, or 10 cents a mile. The revenue from this source was nearly 30 per cent as great as that from passengers. The 39th Street Ferry to Brooklyn, which is the other municipal ferry, carried 458,440 vehicles at an average cost of a trifle over 26 cents per trip, or 9 cents a mile. In this case the revenue from vehicles was three times as much as from passengers, for nowadays people use the bridges and tunnels. As the other ferries carry many more vehicles than the Staten Island Ferry in proportion to the passengers, but probably not so many as the 39th Street Ferry, we may fairly assume that the revenue from vehicles is at least as great as from passengers. Therefore we must add another $4,000,000 to the cost of the water barriers.

Even this does not complete the story. Every vehicle that crosses a ferry must waste at least fifteen minutes and usually half an hour or more if we include the necessary delays and the time lost in going out of the way to get to the ferry. If we count the average time lost on the municipal ferries as half an hour to South Brooklyn and three quarters to Staten Island, its value, on a basis to be stated later, is about $135,000 per year in one case, and $165,000 in the other, or about the same as the ferry charges. On the same basis the value of the time lost by all the vehicles on all the ferries is approximately $4,500,000 per year.

To get the total cost of the ferries we must add the cost of the municipal ferries, $2,230,000 per year; the fares paid by passengers on the other ferries, $3,840,000 per year; the fares paid by vehicles on the other ferries, about $4,000,000; and the value of the time lost by vehicles on all the ferries, about $4,500,000. This makes a total of approximately $14,500,000. Since part of this is based on estimates instead of exact figures we shall come nearer the truth if we say that the ferries cost New York from twelve to sixteen million dollars each year. So much for one item in the expense of the city's water barriers.

The more the New Yorkers have thought about their ferries, the less they have liked them. When one has time and the weather is good, the ferry trip is all right, but when one is in a hurry and it is stormy, some other way of getting across the water is pleasanter. Moreover, it is much cheaper not to have to transfer from one mode of conveyance to another. Therefore agitation for a bridge to Brooklyn was begun years ago. It finally took form in the Brooklyn Bridge, begun in 1872 and finished in 1883. Since then three other great bridges over the East River have been completed. A fifth, the Hell Gate Bridge, which will soon be open, does not cross from Manhattan to Long Island, but from the Bronx. As truly as the others, however, it is a means of overcoming New York's water barriers. With the exception of the bridge over the Firth of Forth in Scotland, New York has the four longest bridges in the world, their length varying from

6,000 to 7,500 feet while that of the Forth bridge is 8,100 feet. The New York bridges, too, have some of the longest spans in the world. Among suspension bridges the Manhattan, Brooklyn, and Williamsburg Bridges, with spans of 1,470, 1,595, and 1,600 feet respectively, are unrivaled. The Hell Gate Bridge, with a span of 995 feet, is the largest arch bridge in existence, the next being the Niagara Clifton Bridge with a span of 840 feet. Among cantilever bridges alone does the palm go elsewhere, for although the Queensboro Bridge has a span of 1,182 feet, it is much exceeded by the Firth of Forth Bridge, whose longest span is 1,710 feet, and the Quebec Bridge over the Saint Lawrence which is now being built with a span of 1,800 feet.[1] It is an astonishing fact that of the world's seven largest bridges five should be in the midst of the world's largest city.

Over the four East River bridges there pass each year six or seven million foot passengers. We will not include them in our estimate of the expense of the water barriers, for in most cases their walk probably does them good. A far larger army of about 120,000,000 people in 1913 and probably 130,000,000 in 1915 rides in surface cars, and about 115,000,000 in elevated trains. There is no way of estimating how much these people pay for transportation, since the fare for the bridges is not separated from the fare on dry land. We can get at the cost in another way, however. The number of round trips made by the surface cars was 3,660,000 in 1913 and close to 4,000,000 in 1915, while the number of round trips of elevated cars was 1,767,000 in 1913 and probably close to 2,000,000 now. The cost of running the surface cars is estimated by the Public Service Commission as about fifty cents for a round trip, while for elevated cars the expense is thirty cents. This means that the necessity of running the cars over the waste space of the four East River bridges costs the transportation companies $2,600,000 a year, which means that it must cost the public not far from $3,000,000.

Large as this sum seems, it is only a beginning. Think how much it costs to drive more than 8,000,000 vehicles across the East River bridges each year. An actual count shows that in a single day in October the four bridges were crossed by something like 7,500 one-horse vehicles, 5,000 two-horse vehicles, 500 three-horse vehicles, and 12,000 motor vehicles. All these vehicles drive much unnecessary distance in crossing the bridges, and in reaching them. Suppose that each one-horse vehicle, including horse, driver, and equipage, is worth $4.00 for an eight-hour day. Such a vehicle may be supposed, on the average, to go at least half a mile out of its way in order to reach a bridge and a mile and a half in order to cross it. That will take half an hour at a moderate estimate, and the cost will be about $675,000 per year. Suppose that the two-horse vehicles, with their drivers, are worth $5.00 a day. As they go slowly, they will not average more than a mile in twenty minutes, and the value of the time which they spend in getting to the bridges and crossing them will be about $800,000. We may suppose that the three-horse vehicles are worth $6.00 a day, which is a decidedly small figure. It will cost them $80,000. Finally, the various types of automobile vehicles may be assumed to be worth at least $10.00 per day. Although they will go faster than the horse vehicles they are subject to such frequent delays that it is safe to say that the average time lost on the bridges is at least ten minutes and probably more. If it is only ten minutes the value of the time thus consumed amounts to not far from $900,000. Thus the long string of vehicles that continually promenades across the bridges, year after year, from early morning until late at night, is obliged to waste time worth about $2,455,000 each year. Since there are a considerable number of other vehicles, such as push carts, not to mention horses that are led across, the total cost of the time lost is at least $2,500,000. This is item number two for the East River bridges.

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[1] For these figures I am indebted to the engineering firm of Lindenthal, New York City.

The third item is maintenance. In 1913, the last year for which reports have been published, the cost of maintaining the four great bridges was about $720,000. To this should be added depreciation, which would be about $580,000 if we estimate the life of the bridges as one hundred years. Finally, the last item in the indictment against the East River is the actual cost of the bridges themselves. The cost of construction was $58,000,000, and that of the land for their approaches about $32,000,000, making a total of $90,000,000. The interest on this at 4½ per cent, which is what the city generally paid at the time when the bridges were built, is $4,050,000. To all this must be added the fact that the mere business of administering the bridges involves an expense of about $120,000 for salaries, offices, and the like.

Here, then, is the annual cost of the four great bridges:—for operating the cars, $2,600,000; for time wasted by vehicles, $2,500,000; for maintenance and repairs, $720,000; for depreciation, $580,000; for interest, $4,050,000; and for administration, $120,000; making a total of $10,570,000.

Not even yet are we through with the bridges. Thus far we have been talking only about the four already completed between Manhattan and Long Island. The fifth, the Hell Gate Bridge, is nearing completion. Its estimated cost, including approaches, is $25,000,000, and it will doubtless add nearly one-fourth to the sum just stated as the total.

New York has also many other bridges. There are at least eight wagon bridges in addition to several railroad bridges over the Harlem River, while in other parts of the city numerous minor bridges cross little bodies of water of no special importance. In 1913 the maintenance of all the bridges, aside from those over the East River, cost $490,000. Their capital cost, including land, was about $31,000,000, which means an interest charge of approximately $1,400,000. There are no figures as to the traffic over these bridges. We may attempt to estimate this by figuring that the traffic per square foot of *area* rather than per foot of *length* is as great on these bridges as on the

East River bridges. Of course many are narrow, so that in proportion to their area they are not nearly so important as in proportion to their length. On this basis the cost of the time lost by vehicles would be about $1,400,000, while the cost of running cars and trains on the bridges would be about $1,500,000. Depreciation on the basis of one hundred years of life for each bridge would be $170,000. Adding these figures we get $4,960,000 for the minor bridges. With the East River bridges this makes the enormous total of $15,530,000 for the bridges actually in operation, while the new Hell Gate Bridge will bring the total not far from $18,000,000. This, it must be remembered, is what the bridges cost the city each year.

Ferries and bridges are only two of the great items in the cost of the water barriers. The third, and probably eventually the greatest, is the tunnels. Thus far New York has seven sets of tunnels in operation. Each consists of two parallel tubes. Three of the tunnels pass under the main Hudson to New Jersey, and four under the East River to Long Island. Although one of the two Hudson and Manhattan tunnels to New Jersey was begun in 1874, it was not opened till 1908. The other Hudson and Manhattan tunnel was opened the next year, while the third Jersey tunnel, that of the Pennsylvania Railroad, was completed in 1910. The East River tunnels are even more recent. The Battery tunnel connecting the Subway with Brooklyn and the Belmont tunnel at 42nd Street were indeed finished in 1908, and the Pennsylvania tunnel in 1910, but the Queensboro tunnel was not opened till 1915, and there are still four more tunnels to be completed to Long Island. It is almost impossible to determine the precise cost of all these tunnels.[2] The Hudson and Manhattan system cost

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[2] The following letter, which was kindly sent me by Mr. T. H. Whitney, Secretary of the Public Service Commission for the New York City District, gives some interesting facts about the later tunnels and also illustrates the difficulties of estimating the cost of the tunnels:—

Since the receipt of your letter of January 8, inquiring for cost data upon the river tunnel sections of our rapid transit railroads, I have been endeavoring to get such information. I find, however, that it is impossible to segregate the figures. The best I can do, therefore, is to give you an approximation.

The existing Battery tunnel of the first Subway was constructed under Contract No. 2, which embraced the Subway from City Hall, Manhattan, south through Broadway to Bowling Green and thence to and under the East River to Joralemon Street, Brooklyn, and thence to the present terminus of the Subway at Atlantic and Flatbush Avenues. While this work was done for the city upon a bid of $3,000,000, its cost was very much greater, and I have seen it stated that the total cost of the Brooklyn extension was in the neighborhood of $10,000,000. Just what proportion of this was spent upon the tunnel proper would require an examination of the construction company's books.

This Commission recently has awarded contracts for three new tunnels under the East River together with approaches on either side, and I can give you the total contract prices, but as none of them is near completion it is impossible to estimate what the cost of extras or additions may be. These tunnels are as follows:

For New York Municipal Railway Corporation, Whitehall Street, Manhattan, to Montague Street, Brooklyn, $5,974,809.50;

For Interborough Rapid Transit Company, Old Slip, Manhattan, to Clark Street, Brooklyn, $6,469,916.25;

For New York Municipal Railway Corporation, 14th Street, Manhattan, to North 7th Street, Brooklyn, $6,639,023.50.

The Commission has yet to award another tunnel under the East River, running from 60th Street, Manhattan, to North Jane Street, Long Island City, but bids for this work have not yet been invited.

Somewhat more complete information is available for the Steinway Tunnel, now known as the Queensboro Subway, which, under the Dual System contracts, was purchased by the city in uncompleted about $55,000,000, and the cost of all the tunnels is sometimes given as close to $200,000,000. As these figures include a certain amount of subway construction on land as well as under water they are too high. An approximation, however, may be reached in another way. In 1914 about 60,000,000 people went through the Hudson and Manhattan tunnels; 27,000,000 of these paid seven-cent fares, and the rest five. The total passenger fares received by the Hudson and Manhattan Company amounted to $3,500,000 that year. If we make allowance for the fact that a part of this sum was paid for land transportation, the cost of passing under the river must be close to $3,000,000.

For the other tunnels no figures are available. If they necessitate as great expenditures in proportion to their capital cost as do the Hudson and Manhattan tunnels, the total for all tunnels cannot be much less than $10,000,000 each year and may be more.

With a cost of $14,500,000 for ferries, $15,530,000 for bridges, and $10,000,000 for tunnels we find that the people of New York are paying close to $40,000,000 each year to get across their water barriers. Even this, however, by no means ends the matter. Many people not only pay to go through the tunnels but pay two land fares to get home where they would pay only one if there were no water. How many such people there are we cannot even guess, but they must annually spend several million dollars that would be unnecessary if the Brooklyn and Jersey systems of transportation were a unit with those of Manhattan. It is therefore conservative to say that the people of New York are spending $40,000,000 a year to get themselves and their vehicles from one side of the rivers to the other.

Thus far we have not considered freight traffic except as it is carried by vehicles. Every pound of raw materials, food, or manufactured goods that comes to Manhattan or goes out must cross the water. Each crossing costs something. No figures are available, but the total is certainly enormous. Go out on the North or East Rivers any day and watch the train-ferries loaded with freight cars. See how they thread their way far up the East River to reach the tracks of the New York, New Haven, and Hartford Railroad. A single item will illustrate the matter. A few years ago the

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condition for $3,000,000. The owners claimed to have expended upon it $7,730,000 in excess of the $3,000.000 allowed. The city since that time has spent several hundred thousand dollars additional for construction and equipment of this line. It was opened for operation June 22, 1915, and the revenue and operating expenses for the quarter ending September 30, 1915, were:

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|---|---|
| Revenue | $22,322.00 |
| Operating expenses and taxes | 16,008.00 |
| Maintenance of way and structure (included in operating expenses) | 7,663.00 |

As the revenue comes almost entirely from passenger fares at five cents each, representing a one-way movement, and as an equal number of passengers are carried in the opposite direction on free transfers, the total number of passengers carried would be approximately forty times the revenue.

As to the Battery tunnel of the existing Subway, the number of passengers carried through it is indicated by the number of tickets sold at the Brooklyn stations, which was approximately 44,000,000 for the year. As this represents the westbound movement through the tunnel, it may be assumed that approximately the same traffic was carried through the eastbound tunnel.

The cost of operation and maintenance of this tunnel is not segregated in the reports. To make even an approximate segregation would require access to the operating company's payrolls and vouchers.

boat that was accustomed to carry the "Federal Express," the through train between Boston and Washington, was condemned. It was not worth while to buy a new boat, since the Hell Gate Bridge will in a few years permit the New Haven trains to cross to Long Island and there enter the Pennsylvania tunnels and so reach the Pennsylvania Station and the Jersey tunnels. Therefore the Boston-Washington trains do not now pass over the main line between New Haven and Trenton, but make a circuit northward to cross the bridge over the Hudson at Poughkeepsie. This involves a detour of 90 or 100 miles over a poor road. According to the Interstate Commerce Commission the average cost per train-mile on the New Haven road is $1.73. Hence the cost of getting one train a day each way around New York and its waters amounts to at least $120,000 per year.

Other items might be added. For instance about 20,000,000 tons of shipping pass through the Harlem River each year. The cost of opening the drawbridges for the ships has already been included in the cost of maintaining the bridges, but we have not reckoned the delays. At present the draws are open only seven hours a day, which causes not only great congestion but exasperating delays to ships. If the draws were open longer, however, the land traffic would be greatly hindered, which would be still worse. This particular matter does not enter into our calculations because it is a hindrance to water traffic and not to that by land. The question is interesting because it illustrates how land and water traffic interfere with one another.

Taking into account only the hindrances to land traffic, but including passengers, vehicles, and railroad trains, it seems safe to say that our figure of $40,000,000 per year for passengers and vehicles must be raised to $50,000,000 to include freight. In other words the water barriers of Manhattan involve an expenditure of about $10 per year for every man, woman, and child in the city. Think what it means that for an ordinary family in New York there is an outlay of fifty dollars per year simply because the coast of the eastern United States has been depressed a few feet. To be sure, this depression is what has made New York harbor, and the harbor is an enormous source of wealth to the city. An equally good harbor would have been possible, however, without separating the people of metropolitan New York into Manhattan, Long Island, New Jersey, Staten Island, and the New York mainland. One could easily plan the distribution of land and water in such a way that the accommodations for shipping would be practically as good as now, while the hindrance to land traffic would be greatly reduced.

Even yet we are not at the end of the matter. When the New Yorkers found that there was not room enough for them on the ground, they began to try to find room above and below. More than anyone else they have tried to find "a place in the sun," and they have done it by climbing upward. Sky-scrapers are such an everyday thing that people fail to realize that they are a highly peculiar type of architecture which has developed within the last twenty-five years. Like metropolitan tunnels and huge bridges, they are a recent and novel invention. No longer ago than 1889 a nine-story office building in New York was considered remarkable, and there were none so high in any other city. Today New York alone has more than two hundred buildings over fourteen stories high, while three have at least forty stories and rise to heights of about seven hundred feet. Millions of people in the United States have never seen a hill seven hundred feet high. Perhaps the majority of New Yorkers have never seen a natural hill as high as their own highest buildings. In many parts of the country a hill as high as the Woolworth Building, 792 feet, would be called a mountain.

The evolution of the sky-scraper is the direct result of the water barriers of Manhattan. The lower end of the island is so small that it cannot accommodate half the business that would gladly go there. Hence it was natural to attempt to get more space by building higher. The Equitable Building stands upon an acre of ground but has over forty acres of floor space, thirty-eight stories above ground, and three below. New York is so large and influential that its example has carried the sky-scraper all over the country, a fact which is much to be regretted. In huge cities such as Chicago, or still more Boston, which resembles New York in being impeded by water barriers, the sky-scraper may be a necessity. Elsewhere it is usually a mistake. It commonly forms a blot on the landscape, where it rises in ugly squareness amid a host of smaller buildings, and its presence leads to congestion where no such thing is necessary. Only in New York has it become really a thing of beauty. There the number is sufficient to give the effect of a solid mass when seen from the water. Certain individual buildings are objects of high architectural beauty. In future days, when man has learned more about the art of transportation and when he no longer crowds himself into a tight corner where everyone jostles his neighbor, the world will perhaps look upon the finest sky-scrapers much as we now look upon the pyramids of Egypt,—wonderful structures, even beautiful, but not a model for the future.

The sky-scraper was originally due to the excessive value of the land in lower New York. Yet its presence has actually lowered the value in some places. The dark lower stories of sky-scrapers themselves, as well as the low buildings shaded by them, do not rent so well as they did when the new type of building was first introduced. In spite of this the rents in practically all parts of New York are excessive, and the price of land is almost fabulous. Every one who lives in the city is paying a higher rent than would be necessary if the city were built upon the mainland instead of an island. Consider what it means when a square foot of land is worth $583. That is the highest price ever paid in New York or in the world. The next highest is $360 in Pittsburgh, $339.50 in London, and $325 in Boston. The desk at which the writer is now sitting measures 32 by 50 inches, or a little over 11 square feet.

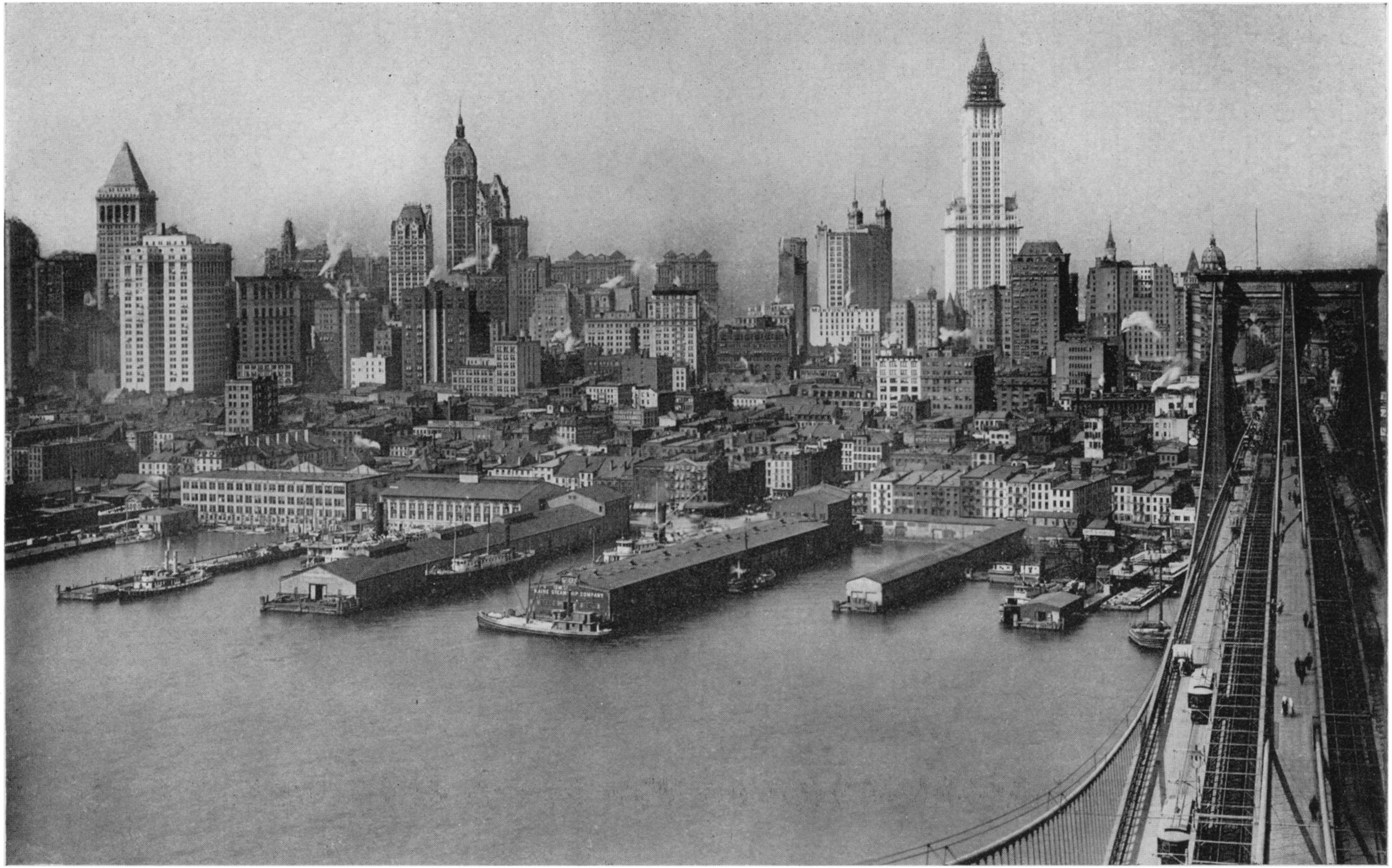

**Fig. 2**—The sky-scrapers of downtown New York. The development of the sky-scraper is due largely to the restricted area available because of the island-nature of the city.

If it were land in Wall Street it would be worth about $6,500. If it yielded an income of 6 per cent a piece of land the size of two such desks would support an ordinary working-man's family in more comfort than is usually the case. The average farmer in the United States has a hundred acres of land and obtains an income less than would be derived from a piece the size of two desks in New York. If he owned one hundred acres in lower New York and it were worth $250 per square foot, he would have an income of $6,000,000. Let there be no misunderstanding: the *income* from a piece of land no larger than an average farm but located around Wall Street would be about six million dollars a year.

This gives an idea of what vast sums New York is paying for rent. The mere fact that it is a large city causes the land to be enormously valuable, but in London, with more people than New York, there is no such inflation of values. The difference is due to the water barriers. How much it may be, no one can tell, but probably the extra rent due to the water barriers is even greater than the amount paid for transportation across them. If this is so, the fact that Manhattan is an island costs the average family in New York at least $100 a year, and possibly more. Only an extremely rich city could stand such a strain.

It might seem as if at last we had reached the end of the indictment of the water barriers. But there is one more phase of the matter. The congestion in lower New York is tremendous. Every day over 750,000 people swarm into the region below 23rd Street by subway, tube, bridge, and ferry, and still others by surface cars and on foot. Such crowding has a bad effect on both health and character. When 15,000 people pour out of a single building in an hour, and when hundreds of thousands pour from other buildings within a space of a few hundred acres, the congestion is enormous. Go down to a subway station between five and six o'clock at night, when the working day is over, and see how the people crowd and jam; go to an elevated station and watch them push for places. Watch them hang from the straps in the cars; watch the interminable line of cars across Brooklyn Bridge. Consider how many people have been rudely crowded and shoved during that one hour; how many tired girls are standing when they ought to be sitting; how many are roughly pushed until they almost fall. How many people of every kind have suffered a nervous shock because of the daily rush; how many have taken cold or become sick, because they have been overtired and have breathed polluted air while wearily hanging to a strap and swinging and jolting from side to side. Because of such conditions how many are today less efficient than they might have been? How many have yielded to temptation in one form or another simply because the nervous wear and tear of the terrible congestion of lower New York have decreased their vitality? All these are things that we must take into account if we would know what the water barriers are doing to the great American metropolis.

In one sense such congestion is found in every city, but because New York is on an island it is greatly exaggerated there. As we look at the effect of New York's water barriers on the cost of living, on architecture, on rents, on problems of transportation, on health, on morals, can we say that man has overcome his physical environment? By our attempts to overcome it, have we not made ourselves a hundred times more subject to it? In the old days of New York when there were 30,000 people, did a single one ever lose his health or suffer nervous breakdown because the water barriers added to the strain of life? A small part of the population was put to extra expense when they traveled, and all had to pay a little more for food because it had to be brought across the rivers. That was the total effect. Today there is not a person in the city who is not directly and deeply influenced by the ferries, bridges, and tunnels, by the high rents, or by the congestion and crowding. The toll now taken by the water barriers is measured in hundreds of millions of dollars and thousands of human characters each year. We may have conquered nature, but in the struggle she has bound us as tightly as we have bound her.

If we would realize how completely modern man is under the influence of his physical surroundings, consider how much more harm a convulsion of nature would do now than ever before. Suppose an earthquake no worse than hundreds that have occurred in other places should shake down New York's bridges and ferry terminals and should open cracks by which the water could flow into the tunnels. What would happen to the city? The starvation, misery, and death that would follow can scarcely be pictured. Hundreds of thousands, if not millions of people would no longer be able to carry on their daily work or procure food.

It is true that such a calamity is not likely to happen because New York is not in a region subject to earthquakes. There is another and much worse calamity, however, which is more likely to overtake us. The nations that were great two thousand or more years ago have all fallen to a low estate with the single exception of Italy, and it has had its Dark Ages. Take Mesopotamia as an example. Because the people neglected their canals or lost the skill and energy to care for them or because they could not ward off enemies, the Euphrates and Tigris Rivers broke loose, the canals were ruined, and the Garden of Eden became no better than a desert. The people of Mesopotamia had conquered nature to a far larger extent than had the Arabs to the south of them or the Kurds to the north. Hence when they lost control their fall was correspondingly great. In their day of power they thought that their dominion would last forever. They failed to discover the causes that were undermining their strength, and their civilization perished from the face of the earth.

Today we are in our hour of greatness. What will happen to us tomorrow? Suppose that luxury, vice, self-seeking, disregard for high ideals, and all the other evils of a decadent nation come upon us. The seeds are here. What if they should grow? Then our control of nature would be lost. Our bridges, poorly repaired by corrupt and inefficient spoilsmen, would fall; our tunnels would begin to leak; our great buildings would one by one collapse. These things could easily happen in a few centuries if once our grip on nature and on ourselves should relax. The only way that we can permanently retain the mastery of nature is by building up human character. Formerly men thought that religion, education, and training were the chief means to this end. In recent generations we have learned that proper food, clothing and houses, abundant fresh air, and freedom from disease also play a highly important rôle in the process. Today we are at last coming to a realization that only by weeding out the weak-bodied, weak-willed parts of the community through some form of eugenic selection, and by seeing that people are adjusted to their physical environment, can we provide proper human material for the great tasks of civilization. We can scarcely avoid the conclusion that the building up of character is as much the work of the scientist as of the preacher, teacher, or philanthropist. Our dependence upon nature, as is shown by the water barriers of New York, is increasing by leaps and bounds. In spite of the constantly growing price that he must pay, man is still master. His mastery, however, depends upon the preservation of his energy, vigilance, industry, inventiveness, honesty, and other high traits of character. Our constantly growing dependence upon nature makes it more necessary than ever before that science should play its part in preserving those traits which alone can render man permanently victorious over his geographical environment.[3]

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[3] For a valuable discussion of City crowding and the interrelations of offices, residences, slums, and factories see the section on congestion in "The Cost of Competition" by S. A. Reeve, Doubleday, Page & Co., Garden City, N. Y., 1906, pp. 285-293.